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REMARKS

In view of the following discussion, the Applicants submit that none of the claims now pending in the application is unsupported under the provisions of 35 U.S.C. §112 or made obvious under the provisions of 35 U.S.C. §103. Thus, the Applicants believe that all of the presented claims are now in allowable form.

I. ALLOWABLE SUBJECT MATTER

The Applicants thank the Examiner for her comments regarding the allowability of claims 44-50, as well as regarding the allowability of claims 5, 6, 10, 11, 20, 21 and 23, if rewritten in independent form to include all of the limitations of the base claim and any intervening claims. The Applicants submit that allowed claims 44-50, previously submitted as new claims, present claims 5, 6, 10, 11, 20, 21 and 23 in such a form. However, in light of the arguments presented below, the Applicants respectfully submit that claims 1 and 16, from which claims 5, 6, 10, 11, 20, 21 and 23 depend, are patentable over the cited references. Therefore, the Applicants respectfully submit that claims 5, 6, 10, 11, 20, 21 and 23 are in allowable form as they stand.

II. REJECTION OF CLAIMS 1-23 UNDER 35 U.S.C. § 112

The Examiner has rejected claims 1-23 in the Office Action for allegedly failing to comply with the written description requirement under 35 U.S.C. §112, first paragraph. Specifically, the Examiner submits that the Applicants' specification does not support the limitation of adjusting, in all three dimensions, a detected text region in captured imagery of a three-dimensional scene, but rather teaches adjusting the effect caused by capturing the three-dimensional scene. The Applicants respectfully submit that the limitation of adjusting, in all three dimensions, a detected text region, is clear and is supported by the Specification; however, the Applicants have amended independent claims 1 and 16, from which claims 2-15 and 17-23 depend, in order to attempt to clarify the limitation to the Examiner's satisfaction.

In particular, the Applicants have amended claims 1 and 16 to recite adjusting,

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"along three axes", the detected text region. The Specification clearly supports such a limitation. For example, in paragraphs [00045] – [00048] and FIG. 3, a method is described for rectifying a text region that lies on a planar surface in 3-D space in which the orientation angle of the text region relative to the optical axis of the camera is modeled in terms of three angles: (1) a first angle, θ, that represents rotation of the text region in a plane that is perpendicular to the camera's optical axis; (2) a second angle, ϕ, that represents the horizontal component of the angles formed by the normal to the text plane and the camera's optical axis; and (3) a third angle, γ, that represents vertical component of the angles formed by the normal to the text plane and the camera's optical axis. The three angles θ, ϕ and γ represent the amount of rotation that the text region must undergo relative to the camera in each of three respective axes to yield a frontal, horizontal view of the text region in the camera's field of view.

Thus, the Applicants submit that the amendment to independent claims 1 and 16 clarifies the nature of the Applicants' invention and is clearly supported by the Applicants' Specification. Therefore, the Applicants submit that, for at least the reasons stated above, independent claims 1 and 16 fully satisfy the requirements of 35 U.S.C. §112. Dependent claims 2-15 and 17-23 depend from claims 1 and 16, and recite additional features therefore. As such, and for at least the same reasons set forth above with respect to the rejection of independent claims 1 and 16, the Applicants submit that claims 2-15 and 17-23 also fully satisfy the requirements of 35 U.S.C. §112. Accordingly, the Applicants respectfully request that the rejection to claims 1-23 under 35 U.S.C. §112 be withdrawn.

III. REJECTION OF CLAIMS 1-4, 9, 12-19 AND 22 UNDER 35 U.S.C. § 103

The Examiner rejected claims 1-4, 9, 12-19 and 22 under 35 U.S.C. §103(a) as being unpatentable over the Tyan patent (United States Patent No. 6,473,517, issued on October 29, 2002, hereinafter Tyan) in view of the Kielland patent (United States Patent No. 6,081,206, issued on June 27, 200, hereinafter "Kielland"). Although the Examiner states on page 3 of the office action that the rejection is made over Tyan in view of the Dance et al. patent (United States Patent No. 5,512,539, hereinafter

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"Dance"), the remainder of the rejection discusses Tyan in view of Kielland and makes no further reference to Dance. In view of this fact, as well as the fact that Dance is not listed on the Examiner's Notice of References Cited, the Applicants assume that the Examiner meant to state the rejection over Tyan in view of Kielland, and the Applicants will address the rejection as such. The Applicants respectfully traverse the rejection.

Tyan teaches a method for recognizing a license plate number in an image of a license plate. A captured image of a license plate is preprocessed in at least one of two ways to enhance subsequent character recognition results. A first preprocessing technique compensates for tilt or skew of the license plate along a single axis in the image by adjusting (e.g., rotating) the image in the axis of tilt (see Tyan, column 5, lines 40-46: "A license plate ... is tilted by an angle with respect to the horizontal axis ... [T]his angle is then corrected to give an image with a rotation angle of about zero degrees ..."). In a second refinement step, the position of the license plate within the image may be further refined by cropping regions of the image that are not necessary for recognition of the license plate number (e.g., the plate frame or the body of the vehicle to which the plate is attached; see, Tyan, column 5, lines 51-53: "It is necessary to perform a refined localization that leaves out unnecessary regions but retains plate characters."). Once the region of the license plate is localized in this manner, portions of the license plate number may be iteratively segmented into suspected character regions, which are subjected to optical character recognition (OCR) processing in order to identify the license plate number depicted in the captured image.

Kielland teaches a method for enforcing parking regulations by performing license plate recognition on parked vehicles to determine how long a vehicle has been parked in a particular spot. The license plate number of the vehicle is captured by camera, time tagged, geo-referenced and entered in a local database as an enforcement officer makes his or her patrol route. When the enforcement officer re-traces the patrol route after a parking time limit has expired, the database is searched to determine which vehicles have been parked at the same locations for a longer period of time than is permitted by the parking regulations. Parking citations are then printed for any offending vehicles. The method uses a license plate recognition process in order to

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digitize the license plate numbers of the vehicles (*e.g.*, for storage in the database) from the captured images. One step of this process includes "deskewing" the characters of the license plate numbers, *i.e.*, correcting distortion of the characters caused by camera angles.

The Examiner's attention is directed to the fact that both Tyan and Kielland fail to disclose or suggest the novel invention of performing an adjustment of a detected text region along three axes to produce a rectified or corrected image, as claimed in Applicants' independent claims 1 and 16. Specifically, Applicants' claims 1 and 16 positively recite:

1.   Method for recognizing text in a captured imagery, where said captured imagery is of a three-dimensional scene, said method comprising the steps of:
        (a) detecting a text region in the captured imagery;
        (b) adjusting along three axes said detected text region to produce a rectified image; and
        (c) applying optical character recognition (OCR) processing to said rectified image to recognize the text in the captured imagery. (Emphasis added)

16.   Apparatus for recognizing text in a captured imagery, where said captured imagery is of a three-dimensional scene, said apparatus comprising:
        means for detecting a text region in the captured imagery;
        means for adjusting along three axes said detected text region to produce a rectified image; and
        means for applying optical character recognition (OCR) processing to said rectified image to recognize the text in the captured imagery. (Emphasis added)

Applicants' invention is directed to a method and apparatus for recognizing text in an image sequence of scene imagery, *e.g.*, where the text information is incidental to some other subject being recorded and the position or angle of the text information may therefore render the text difficult to recognize using conventional OCR methods. In many circumstances, it is desirable to identify incidental text information captured in an imagery (*e.g.*, a three-dimensional scene of the real world), such as a name on a street sign. Conventional text recognition programs and systems typically operate on the assumption that the text lies in a plane that is orientated roughly perpendicular to the

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optical axis of the camera (*e.g.*, as in the case of a document placed on a scanner). However, in the case of text that is incidental to a main subject being recorded, such as text on street signs, billboards or name plates, the text often lies in a plane that is sloped, slanted or otherwise distorted relative to the optical axis of the camera, and the text therefore may not be easily or accurately recognized by conventional OCR methods.

The present invention provides a method and apparatus for recognizing text in a captured imagery in which detected text regions are adjusted along three axes (*e.g.*, horizontal, vertical and torsional/depth) to account for distortion due to non-perpendicular alignment with an optical axis of a camera recording the imagery. The detected text regions may be both rotated and stretched to produce a rectified (*e.g.*, distortion-compensated) image. These rectified images are then subjected to OCR processing in order to recognize the text contained therein. Thus, by adjusting the text regions along three axes, the method can compensate for non-perpendicular text orientation angles, thereby producing a more accurate result.

In contrast, Tyan teaches a method for preprocessing a character region in a captured image of a license plate by adjusting the character region along two axes at most (*e.g.*, horizontal and vertical), and then cropping extraneous imagery in the captured image. In other words, Tyan only teaches adjusting the text regions in no more than two dimensions followed by a simple cropping operation, which does not amount to an adjustment along three axes as claimed by the Applicants. The Examiner concedes in the Office Action that Tyan does not teach adjusting the text region in "all three dimensions" (*e.g.*, along three axes). The Examiner submits, however, that Kielland discloses that rectification of perspective distortion caused by oblique camera angles is well known in the art. The Applicants respectfully disagree with this conclusion. In particular, the Applicants submit that the portions of Kielland cited by the Examiner specifically describes the geometric rectification as being as being "generally referred to as "deskewing" (*See*, Kielland, column 5, lines 48-50).

The Applicants submit that the present record clearly demonstrates the generally accepted meaning of "deskewing" (or "the removal of skew effect") in the art. For

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example, Tyan describes (at column 3, lines 48-51): "To enhance the performance of character segmentation, the present invention performs image preprocessing to deal with plate skew ...". At column 4, lines 56-57, Tyan teaches: "In block 16, plate tilt or skew is detected and accounted for".

As Tyan's teachings already contain deskewing, the portions of Kielland cited by the Examiner provide no additional relevant teachings over Tyan. As the Examiner concedes that Tyan fails to anticipate the Applicants' invention, the combination of Tyan with Kielland also cannot anticipate or make obvious the Applicants' invention.

Specifically, Tyan and Kielland, singularly and in combination, only teach the detection and/or correction of skew in an intentionally captured image of a vehicle license plate due to a tilt of a captured character region along a single axis. The skew correction requires adjustment of the character region in two dimensions, at most (for example, the text may be rotated relative to a horizontal axis). Neither Tyan nor Kielland addresses the need to recognize incidental text in a video image, e.g., where the text may be distorted due to a non-perpendicular camera angle and can not be read merely by rotating the text region relative to a single axis. Tyan in view of Kielland thus fails to teach or make obvious a method of recognizing text in a captured imagery wherein a detected text region is adjusted "along three axes to produce a rectified image", as positively claimed by the Applicants in claims 1 and 16. Therefore, the Applicants submit that, for at least the reasons stated above, independent claims 1 and 16 fully satisfy the requirements of 35 U.S.C. §103 and are patentable thereunder.

Dependent claims 2-4, 9, 12-15, 17-19 and 22 depend from claims 1 and 16, and recite additional features therefore. As such, and for at least the same reasons set forth above with respect to the rejection of independent claims 1 and 16, the Applicants submit that claims 2-4, 9, 12-15, 17-19 and 22 are not made obvious by the teachings of Tyan in view of Kielland. Therefore, the Applicants submit that dependent claims 2-4, 9, 12-15, 17-19 and 22 also fully satisfy the requirements of 35 U.S.C. §103 and are patentable thereunder. Accordingly, the Applicants respectfully request that the rejection to claims 1-4, 9, 12-19 and 22 under 35 U.S.C. §103 be withdrawn.
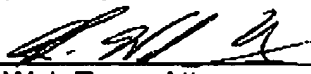
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IV. CONCLUSION

Thus, the Applicants submit that all of the presented claims now fully satisfy the requirements of 35 U.S.C. §112 and §103. Consequently, the Applicants believe that all of the presented claims are presently in condition for allowance. Accordingly, both reconsideration of this application and its swift passage to issue are earnestly solicited.

If, however, the Examiner believes that there are any unresolved issues requiring the issuance of a final action in any of the claims now pending in the application, it is requested that the Examiner telephone Mr. Kin-Wah Tong, Esq. at (732) 530-9404 so that appropriate arrangements can be made for resolving such issues as expeditiously as possible.

Respectfully submitted,

_5/16/05_
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